NUI Galway
OÉ Gaillimh

Semester 1 Examinations 2016 / 2017

Exam Code(s)	4BCT1, 4BP1
Exam(s)	B.Sc. Degree (Computer Science & Information Technology) Bachelor of Engineering (Electronic and Computer Engineering)
Module Code(s)	CT417
Module(s)	Software Engineering III
Paper No.	1
External Examiner(s)	Dr. John Power
Internal Examiner(s)	Dr. Jim Duggan *Dr. Enda Barrett *Dr. Sam Redfern

Instructions: Answer question 1 (mandatory) and any 3 other questions.
Answer 4 questions in total.
All questions carry equal marks.

Duration	2hrs
No. of Pages	5 (Including cover page)
Department(s)	Information Technology
Requirements	None

Question 1 is mandatory

1: Consider a typical web-based application: an online shop. The application must track users, products, stock levels and completed sales.

(a) Describe at a high level (and with the aid of a diagram) a layered (n-Tier) architecture design which would meet the basic requirements of the system. Include a brief list of typical responsibilities for each layer.

8 Marks

(b) Describe the logic and information flows through the system according to these two use cases:

- (i) A previously registered user logs in and is presented with the shop's home page.
- (ii) A user searches for an item by name, and is presented with a page of results.

4 Marks

(c) Assume that the online shop becomes incredibly successful and has to deal with an increasing number of transactions per second.

- (i) Where are the bottlenecks in the system likely to occur?
- (ii) Describe an alternative software architecture which could be used to alleviate these bottlenecks (there are several to choose from)
- (iii) briefly, what new challenges would this architecture bring?

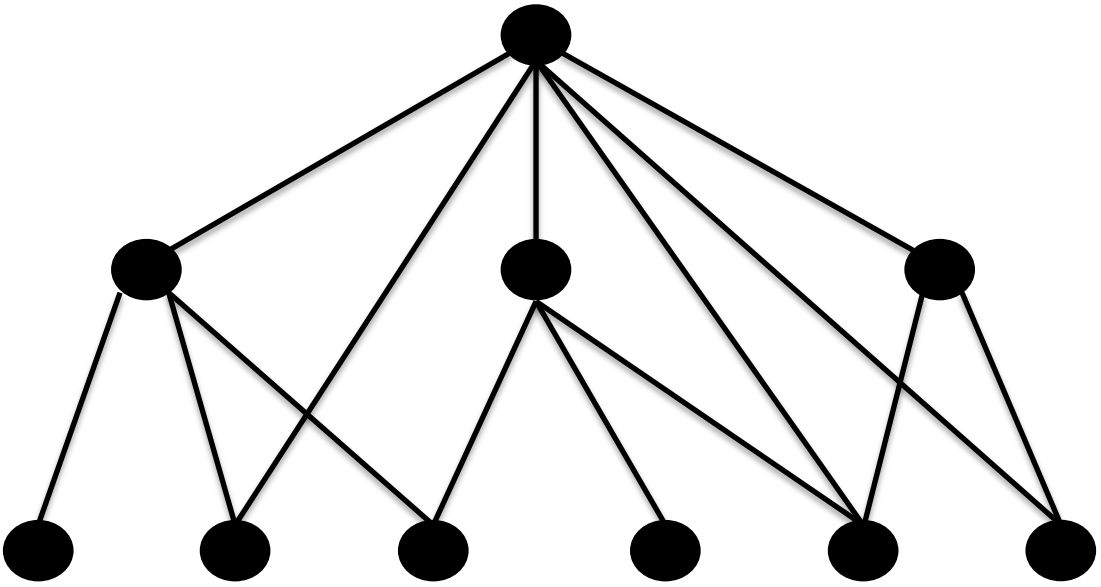
8 Marks

2: (a) Identify the spanning tree for the following software module design, and calculate the values for Tree Impurity (m(G)) and Internal Reuse (r(G))

Remember:

$$m(G) = \frac{number\ of\ edges\ more\ than\ the\ spanning\ tree}{maximal\ number\ of\ edges\ more\ than\ the\ spanning\ tree}$$

$$r(G) = number\ of\ edges\ additional\ to\ the\ spanning\ subtree$$



12 Marks

(b) Draw the following labelled flowgraphs **D_0**, **D_1 D_3**. Include the corresponding pseudocode for each of the program constructs.

8 Marks

3: (a) Assume that the Mean Time To Failure (MTTF) of a software component is 100 time units. Generate a uniform probability distribution function $f(t)$ that describes when the product will fail. Based on this, calculate (graphically) the probability that the software will fail between time 50 and time 75.

8 Marks

(b) A software component fails on average once every 15 days. Assuming a probability density function based on the exponential distribution calculate:

- The hazard rate of the system
- The probability that the system will fail in the first 5 days of operation
- The reliability of the system after 25 days of operation

Remember:

$$f(x) = \begin{cases} \lambda e^{-\lambda t}, & x \geq 0 \\ 0, & otherwise \end{cases}$$

$$P[a \leq f(x) \leq b] = \int_a^b \lambda\, e^{-\lambda t} dt$$

12 Marks

4: (a) In measurement theory, describe the 5 major scale types, Nominal, Ordinal, Interval, Ratio and Absolute. Give an example measure for each scale type and explain why it is important to clearly identify the scale of a software metric.

8 Marks

(b) Describe, using examples, the following object-oriented measures:

- Weighted methods per class
- Depth of inheritance
- Number of children

8 Marks

(c) In measurement theory, discuss the difference between *direct* and *indirect* measurements.

4 Marks

5: (a) Use the box plot method to identify outliers in the following data set for fault density (FD) in a range of software systems. Sketch the boxplot, showing the median, 1st and 3rd quartiles, upper and lower tails and the outliers:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
10	12	13	14	15	15	16	16	18	18	19	21	22	24	33	34	35	36

Describe a standard statistical method that can be used to define measures of association between software measurement variables. Comment on the possible range of values for such a measure, and the meaning of the points [-1, and +1]

12 Marks

(b) Draw a flowgraph and decomposition tree for the following graph.

edges(1,2),(2,3),(2,4),(3,5),(4,5),(5,2),(2,6),(6,1),(1,7)

Discuss how the resulting decomposition tree properties can provide useful information for software developers.

8 Marks

6: (a) Describe the software development practice of continuous integration, include in your answer the benefits of building software this way.

4 Marks

(b) Discuss the difference between branch and line coverage. In the following code example calculate the branch and line coverage produced by a test where isLoggedIn is set to true

```
public void loginStatus(boolean isLoggedIn)
  {
    if(isLoggedIn)
    {
      System.out.println("User is logged in");
    }
    else
    {
      System.out.println("User is not logged in");
    }
  }
```

10 Marks

(c) Explain the purpose of the Project Object Model (POM) for a Maven project. Maven supports inter-project relationships through dependencies. Can you explain what a project dependency is and also what transitive dependencies are?

6 marks